35

X MATERIALS

1968

1,128,764 COMPLETE SPECIFICATION

4 SHEETS

This drawing is a reproduction of the Original on a reduced scale.

SHEETS 3 & 4

Fig.5

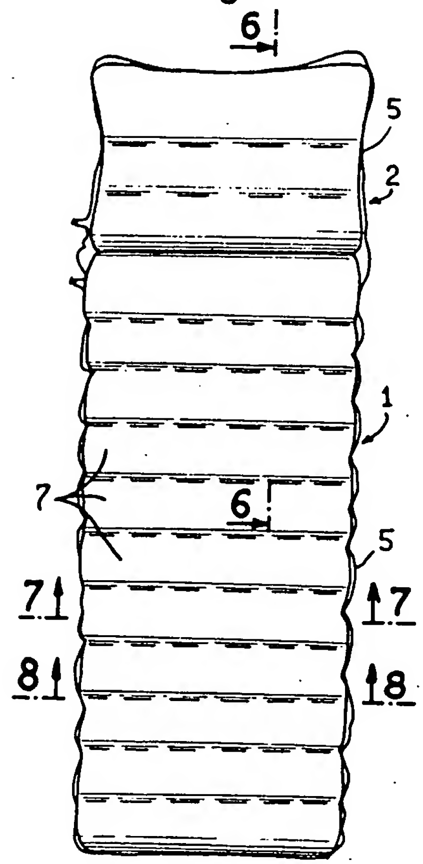
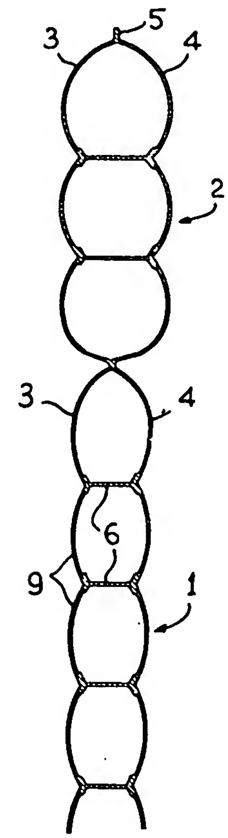


Fig.6



ELASTIC MATERIAL

Fig.7

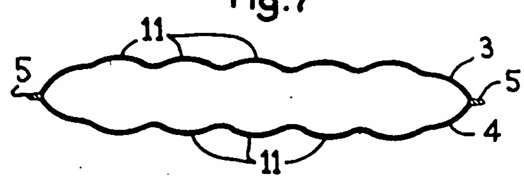


Fig.8

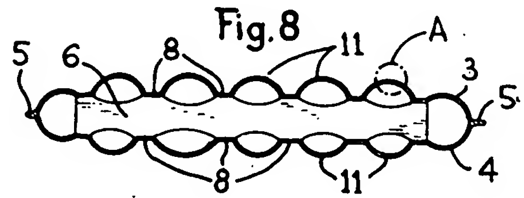


Fig.9

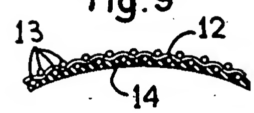


Fig.1

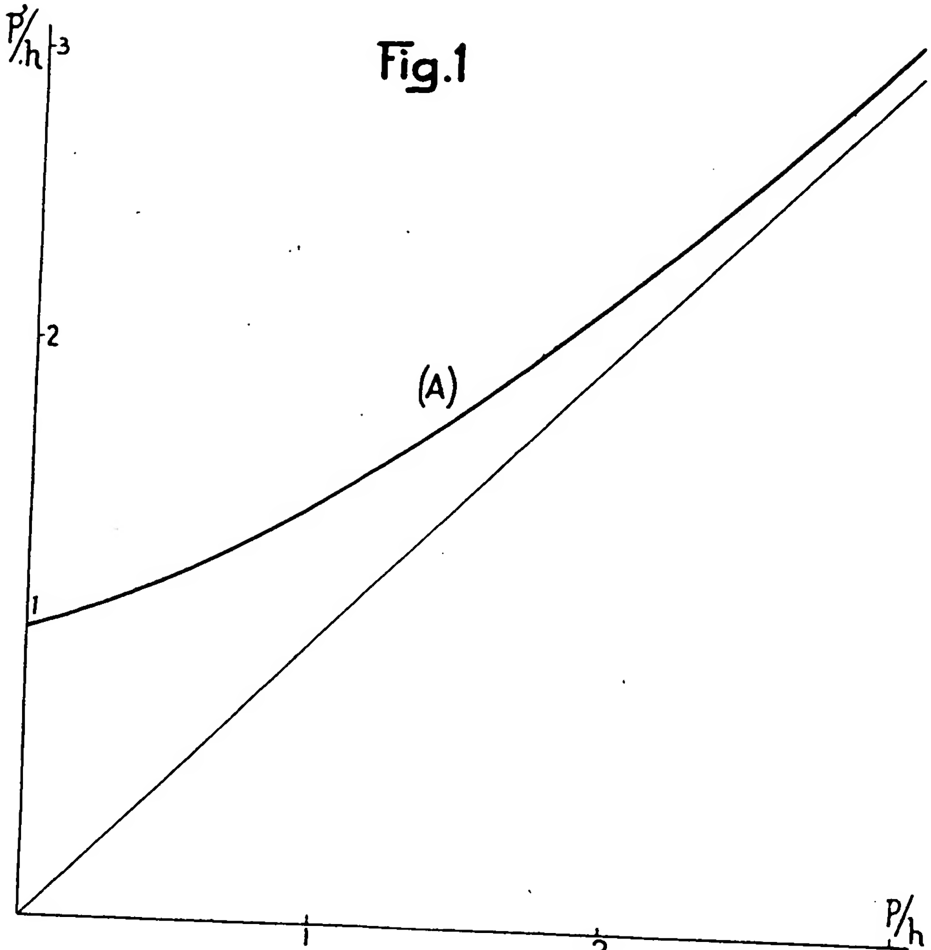


Fig.4

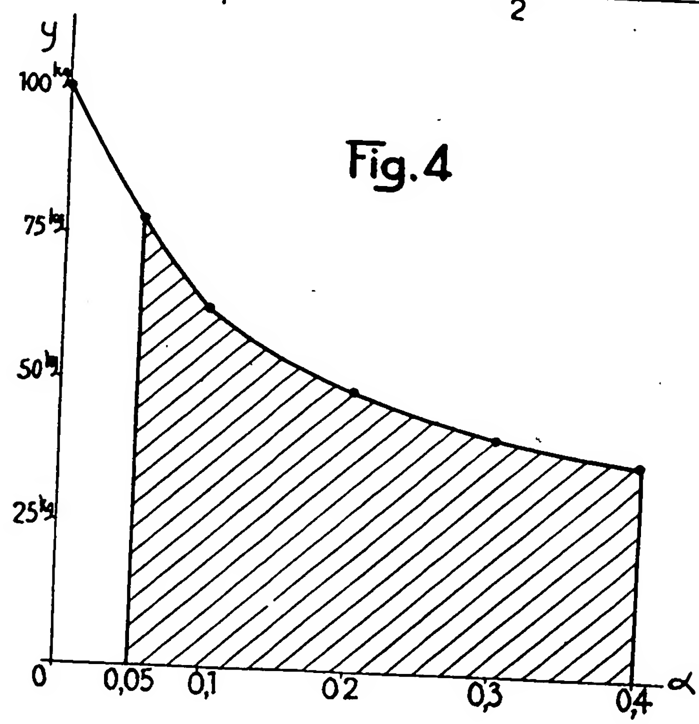
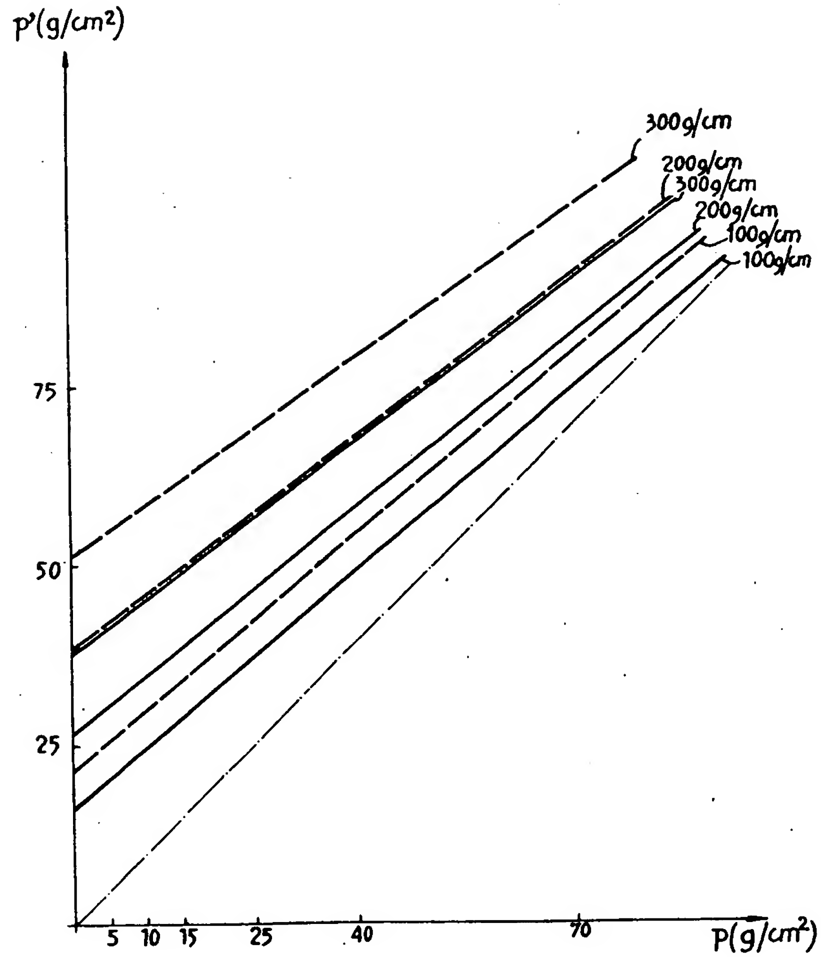


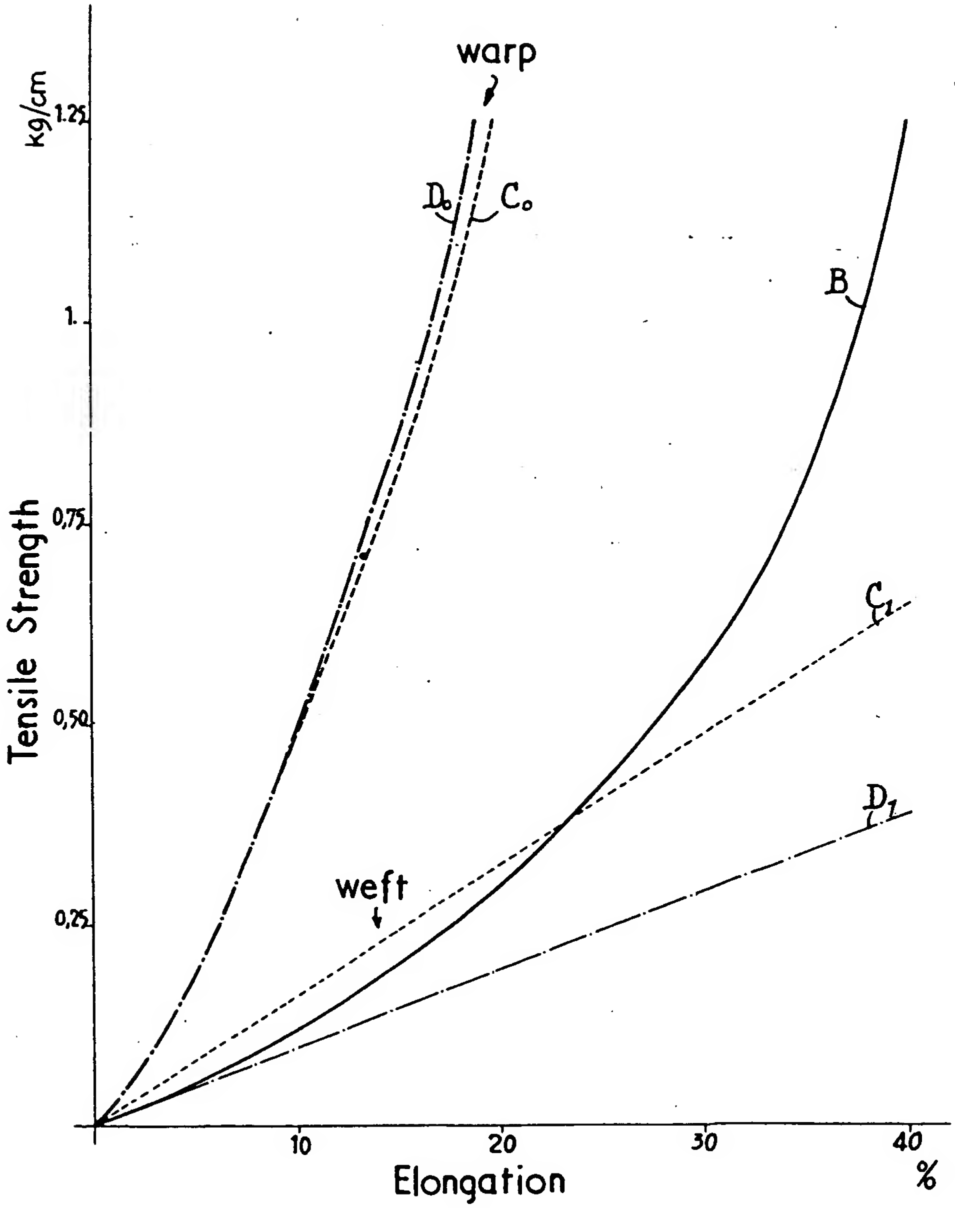
Fig. 3



P'(g/cm²)
300g/cm
200g/cm
300g/cm
200g/cm
100g/cm
100g/cm
75
50
25
5
10
15
25
40
70
P(g/cm²)

1,128,764 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale.*
SHEETS 1 & 2

Fig. 2



PATENT SPECIFICATION

1,128,764

DRAWINGS ATTACHED

1,128,764

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Int. Cl.:—A 47 c 27/08

COMPLETE SPECIFICATION

Improvements in and relating to an Inflatable Article such as an Air Mattress

We, ETABLISSEMENTS PENNEL & FLIPO, a French Body Corporate, of 143, Rue de Constantine, Roubaix (Nord) France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The rubberized fabric employed in the manufacture of inflatable articles such as air mattresses, pillows, cushions and the like is a material having little extensibility. The Applicant has discovered that the comfort of an inflatable article, and more particulary an air mattress, can be greatly improved by employing as the material a fabric which is at least partially elastic or extensible known *per se*.

The object of the invention is therefore to provide a new application of elastic fabrics in the form of an inflatable article constructed at least partially from a fabric having a coating containing an elastomer or plastomer and having an elasticity in at least one direction. The expression "fabric" is intended to be understood in the widest sense, that is, it designates not only fabrics obtained by weaving but also for example knitted, run-resistant, interlock and jersey fabrics and non-woven fabrics. As concerns the notion of elasticity it will be explained in the ensuing description of investigations and tests carried out by the Applicant.

1) Definition of comfort.

There are two fundamental conditions as concerns comfort:

a. In a given position of the sleeper, the comfort, which may be termed static comfort, is the greater as the enveloping of the sleeper is greater. In other words, in the most favourable case, the weight of the sleeper is distributed over the largest area of the body and under these conditions the unit pressure to which each part of the body is subjected—which is the ratio between the weight P of the sleeper and the surface of contact S—is minimum.

This pressure $p'=\frac{P}{S}$ is a measure of the hardness or "discomfort" of the mattress.

In the case of an air mattress this pressure p′ is identical at all points of contact and equal to the internal pressure of the mattress during use, which differs from the initial inflation pressure *p*.

b. From the dynamic point of view, in the event of a movement of the user on the mattress, a large increase in the pressure or particular points of high pressure should not be produced. In particular, as in the case of a conventional mattress inflated only to a slight extent, to satisfy the condition of static comfort, the elbow must not reach the ground through the mattress.

For a mattress of conventional type, experience has shown that contact with the ground through the mattress is avoided if this mattress is inflated beyond a limit value L.

Under these conditions, the comfort in motion is achieved when:

$$p \geqslant L$$

In practice, L is chosen between 8 and 20 g/sq: cm. depending on the height of the mattress.

It will be observed that in the present study what is termed pressure designates in fact an overpressure with respect to the external pressure.

2) Study of the comfort of a conventional air mattress.

The pressure of utilization p′ is distinctly greater than the inflation pressure. For example, a mattress inflated at a pressure p=20g/sq.cm. would easily have a pressure of utilization p′=60 g/sq.cm., which is the measure of the discomfort of the mattress. It is therefore of interest to decrease the value p′.

Whence a minimum value of the coefficient of elastic elongation α determined by:

$$\left(\frac{h_C}{h_E}\right)^3-(1.2)^3=1+2\alpha AR$$

Whence a=5% per kilogram of load when R=8 cm.

No fabric at present employed in inflatable articles satisfies this minimum condition of comfort, these fabrics having a coefficient α of the order of 0.5%.

According to the invention it is possible to obtain a comfort greatly exceeding this minimum.

Let it be assumed that the optimum static comfort is given by a mattress according to the invention which, under the weight of the sleeper, behaves as a conventional mattress which supports a sleeper of the same size but having half the weight.

If h_o is the value of *h* for the conventional mattress, which defines the behaviour of the mattress:

$$h_o^3=\frac{G^2A}{\pi^2R^2}$$

For half the weight $(G\rightarrow\frac{G}{2})$ h_o^3 becomes $\frac{h_o^3}{4}$

The elastic mattress must therefore have a value of h given by:

$$\frac{h_c^3}{h_E^3}=4$$

$$1+2\alpha RA=4 \qquad \alpha=19\%/kg.$$

A strip 1 cm wide of gummed or rubberized fabric must have an elongation of 19% under the action of an overload of 1 kg.

It has been seen hereinbefore that the comfort in motion is obtained on condition that the mattress is inflated above a limit value below which the body would be liable to encounter the ground through the mattress.

If the following numerical values are taken:

Force applied per 1 cm of air compartment G=200 gram/cm

Radius of the air compartments R=8 cm

There is obtained: h_E=25 grams/sq.cm (elastic mattress α=19% per kg) h_c=40 grams/sq.cm (conventional mattress)

The following table gives the calculated values of the initial inflation pressures of the mattress in respect of several pressures of utilization.

Pressure of utilization p' (gram/sq.cm.)	30	35	40	45	50	60
Inflation pressure of a conventional mattress (p)	impossible	impossible	0	13	30	42
Inflation pressure of the elastic mattress according to the invention (p)	12.5	22	30	37	44	56

It is impossible to employ the mattress according to the invention inflated to a greater extent initially to obtain the same static comfort (p'). In other words, the elastic mattress provides both static comfort and comfort in motion.

As concerns a large-size mattress, the inflation pressure of 13 gm/sq.cm is sufficient to ensure the comfort in motion

The pressure of utilization is then:

For the conventional mattress: 45 gm/sq.cm.

For the elastic mattress: 30 g/sq.cm.

5) *Examples*:

a. Elastic cotton-nylon fabric coated with rubber.

The support or base is a woven fabric the warp of which is of cotton and has low elasticity. The weft is of foam nylon and has within the range of utilization of air mattresses (0—1 kg/cm) a mean elasticity characterized by a coefficient α of 27% per kilogram, as shown on the curve B of Fig. 2, which indicates the elongation as a function of the force in kg/cm in respect of a specimen 4 cm wide.

Smoked crepe No. 1	80
GRS 1551	20
Zinc oxide	8
Utrasil VN 3	15
Suprex Clay	20
Zinc stearate	0.7
Paraffin	1
Calcinated light magnesium	1.5
Clear coumarone resin	2.5
Sunproof improved	8
Naugawhite (alkylated phenol)	4
Sulfur	0.8
Tetramethylthiurame disulfur	2
Colouring agent	2

The corresponding characteristics are given hereinafter:

Vulcanization time at 130 °C	30 min.
Breaking strength in kg/sq.cm.	183
Elongation at rupture	839%
Permanent elongation after rupture	21%
Modulus of elasticity at 300%	17.5 K/sq.cm.

7) Results of tests.

In order to check the aforementioned theories and results of the calculations, curves were plotted as in Fig. 3 showing p′ as a function of p, on one hand, for a conventional mattress of inelastic cotton fabric coated with 27.27—50.50 (dotted line) and, on the other hand, for an elastic cotton-nylon fabric mattress (full line).

These curves, were plotted for loads which were 100 g, 200 g, 300 g respectively per centimeter of air compartment and were distributed over the whole of the mattress.

In another series of tests, the compressed mattress was in communication with a second mattress which was subjected to no load so as to represent the practical case of the sleeper lying on only a portion of the total area of the mattress. The results are not reproduced in the drawing but are comparable to those shown in Fig. 3.

8) Advantages.

To resume the preceding study and stress the improved comfort afforded by the mattress according to the invention, Fig. 4 represents the variation in the apparent weight of a sleeper weighing 100 kg on an air mattress as a function of the elasticity of the coated fabric. In this graph, the hatched portion indicates the range of values of α for the inflatable article according to the invention.

The following advantages can be added to the main advantage of an improved comfort:

Flexibility of the article. For example an elastic mattress more readily assumes the shape of the sleeper.

Possibility of special designs or particular reliefs.

Possibility of manufacturing a comfortable mattress for two people with a single inflating compartment, since, owing to the elastic fabric, the comfort of the first sleeper would be only

and inelastic, or only slightly elastic, in the direction perpendicular to the last-mentioned direction.

11. Article as claimed in claim 1, wherein the fabric is a woven fabric, the weft thread being elastic and warp thread inelastic or only slightly elastic.

12. Article as claimed in claim 1, wherein one of the faces of the article is composed of elastic fabric and the other face of inelastic fabric.

13. An air mattress according to claim 1, comprising transverse elongated air compartments defined by stays interconnecting the two walls of the mattress, said stays being composed of a coated fabric which is identical to that of the walls and whose direction of elasticity is transversal.

14. An air mattress according to claim 1, comprising transverse elongated air compartments defined by stays interconnecting the two walls of the mattress, the edges of the transverse stays being connected to the respective walls along short spaced-apart segments.

15. Inflatable article, such as an air mattress, substantially as described and shown in the accompanying drawings.

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